Interesting days

The who's who in the geospatial sector share their views on how the industry will unfold in the days to come

Geospatial technology is going mainstream. Maps and mapping related content are becoming more pervasive and embedded in everyday life. Continued major investments from the likes of Google, Microsoft, Apple, Amazon and ESRI are making consumer-based mapping, location-based service applications and image base maps truly ubiquitous. As consumerisation of technology increases, the focus will be more on providing value and RoI to the users. So, technology under the hood will take a back seat as users will be mainly concerned about the functionality of applications. Demand for mobile applications will continue to grow, especially in the developing world where the internet and software are accessed on phones and mobile devices. Crowdsourcing will take over as the dominant source of spatial data together with a host of sensors.

The advantages in terms of savings in time, cost and infrastructure offered by cloud computing will urge more of large and small businesses to migrate to the cloud. Data generation will increase dramatically in the next few years that will see an increased empowerment of workers through access to critical data and the provision of tools to interpret and use that data visually. As the number of sources for data generation increase, we will have a much wider selection of data available to choose from. Hence, we are gradually evolving from primarily generating data, to locating and accessing data for real-time analytics and visualisation to make sense out of it.

Synthesis of imagery, point clouds and GIS databases will enable automated feature extraction and information update. Aerial, oblique and mobile mapping data will be used to deliver seamless geospatial content in vertical market applications. Technology advancement in modern airborne and ground-based sensors will support on-demand generation and delivery of data. The time taken for capturing, processing, managing and delivery of information from sensors to users in the field will get shorter. Workflows will evolve towards the deployment of real-time information systems that integrate sensors with software for specific solutions.

Opportunities

There will be a greater need for geospatial solutions that are tailored to specific user problems and industry-specific areas. Designing accessible, friendly and consistent applications that work online/offline and between mobile and the physical world will be more important than ever. As mobile devices become more pervasive, users will ask for easy-to-use tools, which will result in development of new lightweight apps. Geospatial industry will become increasingly interested in what is inside the walls of buildings, as opposed to ending at the building walls as it's done for the past 40 years.

Solution providers who can deliver cloud, SaaS and mobile applications while addressing any security concerns will have the competitive advantage. Adoption of location analytics will continue to grow, integrating maps and simple spatial analysis into business analytics and business intelligence. Consumers will demand for applications that offer a single, unified experience regardless of the platform, device, or access point. With the opening up of GIS via the cloud and cloud services, the world of developers who leverage geospatial services in constructing apps is growing. The

ahead...

largest market for GIS professionals will continue to be in the area of supporting enterprise geospatial infrastructure and applications.

Considering the challenges facing our planet, more solutions will be developed to address inadequate infrastructure, urbanisation, scarce natural resources, security and public safety. There is a growing trend towards building, visualising and exploiting 5D digital worlds to reflect, model, predict and influence change, taking into consideration time, location and the abundance of information located across multi-source databases. Traditional surveying and mapping will take the back stage, as 'street mapping type' data acquisition systems will gain demand across a broad range of applications. Open source GIS will continue to grow and start to take its place among the commercial options as preferred desktop, mobile, and online mapping software.

Skills in demand

For geospatial technology to take its rightful position in helping solve the problems of tomorrow today, a workforce knowledgeable in not just one specific domain, but in several domains to synthesize the understanding of geography with computer science, mathematics and sociology will be required. As the abundance of data grows, demand for skilled data modelers and data architects will increase.

Skills related to mobile and cloud development, along with the ability to understand and make sense of large volumes of spatial data will continue to be in high demand. Those who master emerging cloud services and can deploy them for organisations quickly and efficiently will find themselves run off their feet. There will be an increasing shift towards valuing cartographic data presentation skills, and user interface design in general.

Challenges

The challenge for geospatial solution providers is to adapt to the various changes caused by tightening fiscal belts and increased demands from end users. Solution providers are being put under pressure to invest in the quality of their data and IT systems, whilst facing the challenge of how to best manage data integration. End users will demand more of smart solutions, as they will not have time for lengthy technology integration or training sessions. Applications will need to be developed to work out of the box, have a user interface that matches common everyday consumer applications and seamlessly merge into organisational workflows. There is a need to move beyond the static, passive deployments of GIS and related technologies towards modern, united and dynamic geospatial systems. These systems must fuse multi-source content from sensors in space, in the air and on the ground with software solutions that streamline the creation of actionable intelligence.

Lack of standardisation and technical support for GIS products may make it difficult for GIS vendors to deploy GIS software in the field of cloud computing. Geospatial solution providers will have to concentrate on improving the business value in the solutions they provide, and the high return on investment that is possible when the emerging technologies of cloud, mobile, and sensors can be brought to bear on previously difficult problems.

Jack Dangermond
President, Esri

Technology development and application trends

Four areas really stand out: the emergence of the big data movement, the growing adoption of Location Analytics, a movement towards the "apps" space, and the maturation of the cloud.

The volume of all types of data is exploding, and the IT industry has responded by launching a whole series of technologies to manage and process this flood of data. This "big data" movement uses advanced techniques such as parallel processing, in-stream processing, and related techniques for sifting through massive amounts of data to discover useful information. While geographic data volumes have also been growing, the big data community has recently begun to realize the enormous value of geography and geographic information systems (GIS) in helping to parse and tag in-stream data flows and visualize patterns and trends.

"Location Analytics" has developed into a new solution platform that is creating an explosion of interest in integrating maps and simple spatial analysis into business analytics and business intelligence. Integrating GIS and Business Intelligence (BI) is not a new phenomenon; these types of deployments have been in use for more than a decade. But today there are new industry dynamics guiding cooperation between the geospatial industry and the BI market: business analytics and BI are at the top of the CIO's technology priorities list, and the world understands the digital map and the value of geographic visualisation. These dynamics have created a demand for enterprise-class integration of maps and spatial analytics in BI systems. These capabilities of incorporating maps and spatial analytics with BI represent the segment in the business analytics marketplace known as "Location Analytics".

As mobile devices become more pervasive, our users have asked us to simplify the usability of our tools and create new lightweight apps. One might call this a "front office" or "presentation layer" for ArcGIS. New apps have been introduced that allow geospatial professionals to connect everyone in their organisation to their GIS capabilities. Applications start with simple mapping and visualisation but extend to include analysis that leverages the rich content managed in GIS environments.

> "Gone are the days when a GIS project started with digitizing all of the data. We've evolved from primarily generating data, to locating and accessing data."

Over the last three years, cloud computing has rapidly emerged as a technology trend that almost every industry that provides or consumes software, hardware, and infrastructure can leverage. The technology and architecture that cloud service and deployment models offer continue to be key development at Esri. ArcGIS Online is a complete cloud GIS that provides opportunities for organisations to immediately become more cost-effective, productive, and flexible, and enables them to rapidly deliver new capabilities.

Google Earth and related consumer mapping technologies were first to capitalize on cloud solutions for geospatial data by providing simple slippy maps and consumer experience for map infrastructure. This year, Esri has added a whole new layer of web and mobile user experience technology to its ArcGIS platform. This includes global content, simple web and mobile maps, and a whole world of users sharing geospatial content that radically expands GIS for everyone.

We have also added Esri Maps for Office, which allows Microsoft Office users to easily access and use the ArcGIS Online cloud services for geocoding and making maps in the Microsoft environment.

Data generation, management and usage

The data landscape is changing. We now have a much wider selection of data available, and it comes from many different sources. Remotely sensed imagery is playing an increasingly important role in our projects. Crowdsourced data, initially met with scepticism and concern by the geospatial community, has now gone mainstream. And our planet is being covered with sensors, providing a valuable real time source of geospatial data. But perhaps the most dramatic change we've seen in data generation for geospatial projects over the last decade is that in most cases you don't have to generate it at all–very often it

already exists. Gone are the data when a GIS project started with digitizing all of the data you needed. We've evolved from primarily generating data, to locating and accessing data.

With respect to data management and usage, one of the biggest changes we're seeing is the sheer volume of data out there, and the need for real-time analytics and visualisation to make sense of the data. People are embracing the concepts of GIS in order to dynamically geospatially tag, as well as fence and parse, data for more focused analytics. It also provides tools to visualize and discover spatial relationships in this data.

Key challenges

Our focus is to deliver solutions and apps that don't just "run" on these new platforms, but take full advantage of all their new features and capabilities. Particularly promising is the "desktop/ cloud device" architecture that links geospatial professionals with large audiences of people who want to use geospatial knowledge anywhere and on any device. And throughout all of this our challenge has been to provide a single, unified experience regardless of the platform, device, or access point.

Sectors that demand skilled geospatial professionals

The largest market for GIS professionals will continue to be in the area of supporting enterprise geospatial infrastructure and applications. This marketplace continues to grow and the above mentioned trends will require knowledgeable people in data, technology, and the whole new world of lightweight apps.

In addition, the market opportunity for location analytics is very large. All business analytic solutions can benefit from the geographic perspective. And the use of business analytics is pervasive within public and private sectors – current estimates are that 97per cent of large companies leverage analytics – accounting for approximately 100 million analytic users worldwide.

We are seeing a large and rapidly increasing demand for Location Analytics, with both GIS-savvy organisations and newcomers adopting geospatial solutions and driving utilisation across their enterprise. While the goal is to provide easy-to-adopt solutions that can be immediately impactful to business, as demand continues to grow we will see an increase in demand for more professionals skilled in the implementation and application of geospatial technologies and techniques.

Competitive landscape

New data sources, new platforms, and the move towards the "apps" philosophy are changing the way people think about and use geospatial technology. With the opening up of GIS via the cloud and cloud services, we are seeing the world of developers who leverage geospatial services in constructing apps blossom out and expand. The future belongs to those who can embrace this new modality.

Ola Rollen
President & CEO, Hexagon

Technology development and application trends

With the global trends and challenges facing our planet, we will see an increase in the development of solutions that address inadequate infrastructure, urbanisation, scarce natural resources, security and public safety. Building such solutions will require a modern, united and dynamic set of geospatial technologies that includes surveying, photogrammetry, remote sensing, GIS and cartography. The union of these technologies will be critical. Key technological developments for 2013 include:

- The synthesis of imagery, point clouds and GIS databases for automated feature extraction and information update
- The ability to dynamically collect and update geographic information in the office and the field through the use of mobile devices fused with geospatial software
- The merging of aerial, oblique and mobile mapping data to create, manage and deliver seamless geospatial content in vertical market applications
- The move towards building, visualising and exploiting 5D digital worlds to reflect, model, predict and influence change, taking into consideration time, location and the abundance of information located across multi-source databases
- The migration of data processing, management and delivery to the cloud and in connection with field units for updates

Data generation, management and usage

A key area of improvement will be a shorter lifecycle to capture, process, manage and deliver information from sensors to users in the field.

We will also see an advancement of technology in modern airborne and ground-based sensors to support on-demand generation and delivery of data from the office to the field and back. The integration of sensor hardware and software will enable immediate access and use of information layers. Connecting sensors to the office and supporting the bi-directional communication of data from the field to the office and back will create "dynamic" systems. These systems will allow data generation in the office and the field while connected to information from multiple databases for on-demand processing. Overall, workflows will evolve towards the deployment of real-time information systems that integrate sensors with software for specific solutions.

Key challenges

We have a growing need to understand the impact of our growing population, dwindling resources and inadequate infrastructure in order to influence positive change. The world's expectations for how, where and when information is delivered have changed. Customers expect information on-demand, in a context- and application-relevant form, delivered to the field, in the office and available online for anyone to use. To meet these growing expectations, we need to evolve past the static, passive deployments of GIS and related technologies towards modern, united and dynamic geospatial systems. These systems must fuse multi-source content from sensors in space, in the air and on the ground with software solutions that streamline the creation of actionable intelligence. This will enable organisations to deliver context-relevant "Smart Maps" to users across departmental silos, and into the hands of billions of people around the world.

A modern, dynamic, united geospatial system requires a new paradigm around the concept of the Smart Map. A Smart Map is:

- Fresh – It reflects the most current multi-source information available to provide a complete 5D view of the world, taking into consideration not just location, but time and information, as well
- Accurate – It enables smarter decisions, which can only be made from high-fidelity content sources fused within a Smart Map
- Relevant – The information contained within a Smart Map is solution-, application- and context-specific to meet the needs of a customer's unique workflow
- Active – It updates as the world changes, combining multi-source content from sensors, business intelligence, databases, Web services, social media and multi-media, which is critical to situational awareness
- Mobile – The Smart Map can be taken everywhere and accessed from everywhere. It travels with you and reflects digitally and with high fidelity the dynamic world we live in. The Smart Map is always on and always updating in order to reflect change as change happens

Sectors that demand skilled geospatial professionals

For geospatial technology to take its rightful position in helping solve the problems of tomorrow today, we need a workforce knowledgeable in not just one specific domain, but in several domains to synthesize the understanding of geography with computer science, mathematics and sociology. Skilled professionals must be able to adapt, implement and support dynamic thinking and problem solving. A theoretical understanding of geospatial technologies is not enough. What's needed is the ability to apply and build systems anyone can use in order to fully exploit the power of dynamic geospatial systems. If we are to put information into the hands of billions of people, we need professionals who understand the process and lifecycle associated with modelling, building and deploying smart geospatial solutions. Understanding just one part of this connected lifecycle leaves us open to what the industry suffers from today: static, passive and fragmented systems that are relevant to only a few.

> "A key area of improvement will be a shorter lifecycle to capture, process, manage and deliver information from sensors to users. Technology in modern airborne and ground-based sensors will advance."

Competitive landscape

More and more vendors will begin diversifying and branching out into multiple lines of business that may include, hardware, software, data and solution services in order meet customer needs which are no longer one-dimensional. Within each line of business we will see diversification into vertical markets with solutions that support a complete lifecycle of information and a customer's entire workflow. Moving forward, vendors will add a regional dimension to the picture, emphasising specific solutions for specific regions around the world. True competitive differentiation will come down to those who understand local problems and have the ingredients needed to solve the bigger picture with a complete solution for an entire workflow.

Philip O'Doherty
CEO, eSpatial

Technology development and application trends

Consumerisation of IT – Software and IT will become less about backend functionality and technical specification and more about customer return and value. The ubiquity of everyday applications like Facebook, Youtube and mobile Apps have led to a certain level of expectation from IT services. Customers in both the B2B and B2C worlds will be less concerned with the technology behind the applications and will want applications "that just work." Training, integration and lengthy consultation processes will be less important.

Continuing shift to mobile devices as 'first' device – Mobile will shift focus from the secondary to the primary device. This will be particularly important in developing countries, where the Internet and software are accessed on phones and mobile devices more so then laptops or desktop computers.

For the geospatial industry in particular, well developed mobile (friendly) applications are critical – particularly with the explosion of location-based content across social media with photo geo-tagging, and 'check-ins' for example.

IT and application providers who don't adopt some form of mobile strategy will be missing out on massive opportunities.

Accelerated shift to cloud computing – as with the last five years, the rate of cloud adoption will accelerate in 2013. The infrastructure, cost and time savings that come with leveraging the cloud will lead large and small organisations to move online. Furthermore, increased security and data protection will help in cloud adoption.

Data generation, management and usage

Big data is already starting to be seen as an over hyped concept. There is no denying that data generation will increase dramatically in the next few years but the real developments in data management and usage process will come from exploitation of existing datasets through optimized people, processes and systems.

Big data is a subjective term for most organisations who are even struggling to exploit their "small data." The coming years will see an increased empowerment of workers through access to critical data and the provision of tools to interpret and use that data. For example in the geospatial industry we have already seen an explosion of visual analytics in 2012. I expect this to continue in 2013 and we will see the provision of such tools that make it easier to interpret and use data visually.

> "For the geospatial industry, well developed mobile (friendly) apps are critical. IT and apps providers who don't adopt some form of mobile strategy will be missing out on massive opportunities."

Key challenges

Geospatial solutions will become more and more mainstream as organisations look to more visual and relatable forms of business intelligence. The problem however, will be that end users of these applications will have no time for lengthy integrations or training.

The applications will need to work out of the box and have a user interface that matches common everyday consumer applications and mergers into existing organisational workflows. There will be a greater need to "hide the GIS" and make solutions seamless on the front end.

Additionally, there will be a greater need for geospatial solutions that are tailored to specific user problems and industry-specific areas–giving consumers solutions that easily fit in with how (and where) they work with mobile enabled and cloud solutions. A one-size-fits-all approach to applications will not work for users in roles such as marketing, sales, general management.

Sectors that demand skilled geospatial professionals

Data scientists / analysts – Any organization looking to gain a true competitive advantage from data will be actively seeking talented individuals in the mathematics, statistics and business analytics fields.

The race for analytic talent in high tech regions such as Silicon Valley has led to the data scientist role being described as the "sexiest job of the 21st century." We are likely to see these kinds of skills being sought in technology

sectors, particularly in enterprise telecommunications and online media.

Design – UI and UX – Designing accessible, friendly and consistent applications will be more important than ever. The ubiquity of IT and software will fuel the need for a seamless user experience between online and offline applications and between mobile devices and the physical world.

Competitive landscape

Providers who can effectively deliver cloud, SaaS and mobile applications while addressing any security concerns will do well against competition.

It is abundantly clear that SaaS is a game-changer when it comes to geospatial solutions. eSpatial has invested heavily in developing successful SaaS mapping software and there have been a few others who have married geospatial with SaaS. In the main though, the adoption of online applications and cloud computing has been slow for many geospatial providers. Reluctance to embrace this cannot be ignored any longer by those who want to get ahead.

Dale Lutz
Vice President of Software Development and Co-founder, Safe Software

Technology development and application trends

While the rate of change in nearly every facet of our industry continues to increase, there are four particular areas to keep a close watch on in 2013:

1) Cloud – whether through services like ArcGIS Online or Google Maps Engine offered by the big players, or innovative hosting services offered by disruptors like MapBox, or through "roll your own" solutions put together on top of platforms like Amazon Web Services or Microsoft Azure, the impact of cloud technologies on the spatial industry will deliver big changes to the way practitioners work in 2013.

2) Mobile – the deployment of millions and millions of spatially aware, powerful, interconnected, and portable mobile devices will continue to transform the way that spatial information is produced, consumed, and leveraged. The combination of these devices and their connection to cloud services and each other will result in even more opportunities for spatial information to improve the lives of citizens, the productivity of businesses, and the health of our planet.

3) Sensors – the decreasing cost and increasing accuracy of sensors of all sorts, combined with their conductivity to the Internet will result in 2013 truly being the year that the "Internet of Things" goes from buzzword to reality. These sensors will provide incredible volumes of data for cloud solutions to grind into useful derivations for deployment on mobile devices.

4) Inside – watch for the geospatial industry to increasingly become interested in what is inside the walls of buildings, as opposed to ending at the building walls as it's done for the past 40 years.

> "The impact of cloud technologies on the spatial industry will deliver big changes to the way practitioners work in 2013."

Watch for new applications and solutions to be created that combine these four areas of development and innovative and massively disruptive ways.

Data generation, management and usage

Cloud platforms and cloud technology generally will make a serious impact in the way that data is managed, used and yes even generated. The ability to very inexpensively throw "infinite computing" at problems squares very nicely with the massive data volumes typically brought to bear when solving spatial problems. Expect to see more solutions which involve huge backend processing become widespread in the next few years.

Look for innovative new ways of harnessing the plethora of mobile devices to generate more and better data in increasingly clever ways. Data collection disguised as "game" is definitely something to watch for – check out the recent "Ingress" game for an example.

Key challenges

There are three challenges facing geospatial solution providers in 2013: the economy, the economy, and the economy. Large sections of the world economy are definitely in a slowdown, and as I write this there is much uncertainty nearly everywhere. This ends up impacting all businesses, and those in the geospatial arena are not

immune. Geospatial solution providers will have to concentrate on improving the business value in the solutions they provide, and the high return on investment that is possible when the emerging technologies of cloud, mobile, and sensors can be brought to bear on previously difficult problems. There will be great opportunities for those innovative companies which can create clever, low cost, high value solutions during these tougher economic times.

Sectors that demand skilled geospatial professionals

Certainly skills related to mobile and cloud development, along with the ability to understand and make sense of large volumes of spatial data will continue to be in high demand.

Those who master emerging cloud services and can deploy them for organisations quickly and efficiently will find themselves run off their feet. There will be an increasing shift towards valuing cartographic data presentation skills, and user interface design in general, as a problem shifts from being one of backend processing to front-end presentation on increasingly powerful and mobile screens of a variety of sizes.

Competitive landscape

Look for continued and sometimes surprising consolidation within our industry. Companies that have been successful are sitting on and/or have easy and cheap access to large stockpiles of cash, and so are capable of pulling off acquisitions at an ever-increasing pace.

Watch for the Hexagons, Esris, Trimbles, Googles, Apples, Microsofts, Nokias, and their peers to continue to bolster their solution offerings through an ongoing pattern of strategic company acquisition. There will be an explosion of small players and an increasingly broad range of solutions offered by the big players. Interesting days indeed...

Steven Ramage
Head, Ordnance Survey International

Ordnance Survey International will harness the vast range of skills and expertise within Ordnance Survey to primarily support other national mapping agencies and their countries. Ordnance Survey International aims to provide expert advice and services across the full spectrum of Ordnance Survey's expertise, including data collection and maintenance, product development and geospatial data management. The expert advice will enable international customers to develop and enhance their own business requirements and ultimately reap the benefits, which can be delivered through the efficient management of accurate, maintained GI.

Ordnance Survey international will be offering government to government advice and guidance relating to:

- Capacity and capability building
- Data collection and management
- Geospatial data management
- Market development
- Operational delivery
- Product development
- Programme management
- Supply-chain modelling
- Strategic review and assessment
- Technology direction
- Value of geographic information

Technology development and application trends

The increased reliance on the 'cloud' and the growing recognition of Linked Data are two of the major technological developments, which the industry will experience over next 12 months. Other areas include the ongoing drive for interoperability and access to data, what some have referred to as ubiquitous public access. It may also be the year when augmented reality is given a boost by some activities by the large multinationals. Hopefully, technology will also continue to make a difference in emergency and disaster management, as well as humanitarian response.

Going back to the 'cloud' (DaaS, PaaS, SaaS) over the last 5 to 10 years there has been a significant shift in how geospatial information is managed, hosted, served and consumed. I strongly believe that the use of the 'cloud' is becoming the 'norm' for our industry. In a time of global austerity measures, the 'cloud' offers a platform to host and serve vast quantities of data with a potential reduction in investment costs.

In addition to developments with 'cloud' technology the use of geospatial information in business analytics is also expected to become more dominant as fusing large datasets based on common geographies is now technically feasible.

I also expect to see more data being distributed as Linked Data, which is going to facilitate the tighter integration of business and location data. There are vast amounts of data being generated everyday on the Web and through many different types of sensors. The need to manage and understand this data, and link it to

other associated information is vitally important. I believe that location data is a core element to Linked Data and can play a pivotal role in producing a hyper-connected environment across the Web. This is something that Ordnance Survey has been working on for several years.

Data generation, management and usage

In today's data-driven world, we are seeing geographic data being generated, aggregated and used in many different ways. The combination of data from different sources such as crowdsourcing, authoritative mapping from national mapping agencies and its fusion with business data requires the ability to access and combine a variety of data sources. For the producers and aggregators of this vast amount of the data, the challenge is to how best to manage, maintain and provide access to the information.

In 2011 Ordnance Survey implemented a new, state-of-the-art Geospatial Data Management System (GDMS), providing an integrated, enterprise-wide solution for the management, planning, coordination and control of Ordnance Survey's data capture, integration and maintenance activities. As a result of this massive investment project, Ordnance Survey now has a sophisticated enterprise-wide production system enabling the automated control of data quality, delivering high levels of accuracy and creating a platform from which to launch new data-dependent products and services for customers and end users. All source data is held and managed in one single 3D database in order to integrate and streamline our production processes and synchronise our products. We believe this is an exemplar approach.

How the data is accessed and ultimately used, also varies across the industry, especially as we have increasing numbers of producer consumers or 'prosumers'. Today data users expect to have instant access to data, ranging from open datasets to premium up-to-date large-scale mapping and fit for purpose still plays a huge role. Some of the challenges relate to the different semantics involved, but others relate back to the data integration challenge and being able to share and access data at these different 'viewpoints'.

> "Solution providers are under pressure to invest in the quality of their data and IT systems, whilst facing the challenge of managing data integration."

Key challenges

Everyone is trying to do more with less. Across the world many governments and businesses are experiencing financial restrictions due to poor economic conditions and it is this global austerity which is posing a real challenge for the industry. The challenge for geospatial solution providers is to adapt to the various changes caused by tightening fiscal belts and increased demands from end users.

Customers are continually driving for better value for money and improved products and services. Solution providers are being put under pressure to invest in the quality of their data and IT systems, whilst facing the challenge of how to best manage data integration. As mentioned we are witnessing vast amounts of data being produced on a daily basis and the challenges facing the solution providers are how to filter what data they should be utilising whilst considering data formats and standards.

This also includes the different languages we speak, such as BIM, CAD and GIS. There are a number of efforts underway globally to assess topics, including indoor and outdoor location and the point at which they meet. There are also many initiatives in process where communities are drilling down from a regional or continental view to a country, city or even an individual building view of the world.

Ordnance Survey is very active in this area as we have invested significantly in 3D and BIM integration. In fact one of the members of the Ordnance Survey International team, Carsten Rönsdorf, is a recognised international expert in this field. Carsten has been working extensively with OGC CityGML and the 3D Information Management working group from the Open Geospatial Consortium (OGC), as well as the ISO Technical Committee 211 on these topics, including the integration of building and indoor data into a wider geospatial reference framework.

Sectors that demand skilled geospatial professionals

I strongly believe that the industry needs to invest in skilled data modelers and data architects. The skillset overlaps with IT, but is actually very different from systems architects and developers. The demand for highly skilled people in this area of expertise is only going to increase over the coming years. The abundance of data, especially unstructured data, will place a premium on highly skilled data modelers. It is important that the industry develops a pool of experts who understand the inter-relationships between data models, enterprise architecture and data delivery across the data supply value chain.

I would also like to see the industry develop more design-oriented skills. This can only assist developments in 3D and 4D mapping and provide better insight in to how mapping can be visualised and displayed on multiple devices.

Competitive landscape

Over the last 5 to 10 years, the industry has seen a lot of consolidation and acquisitions, resulting in a significant reduction in the number of small GI companies. With the continuing pressures on budgets, I expect this trend to continue for the foreseeable future. The challenge will be to ensure that we do not lose any of the expert skills or innovative thinking and flexibility they offer, as a result of these changes.

Competition is good for the industry and is a driving force which ensures that we all strive to be market leaders. The industry is not standing still and people are constantly looking at new ways to capture, store and distribute data.

I'm pleased to be leading Ordnance Survey International at a time where governments around the world are investing in geospatial information for decision making and economic growth. Helping these organisations review and develop their strategic thinking is a key part of addressing these challenges.

Tony Frazier
Senior Vice President
Marketing, GeoEye

Technology development and application trends

US Government defence guidance in 2013 will drive significant changes. Anticipated reductions in overall spending will drive IT consolidation and accelerate the move to cloud based service applications.

In the commercial market, continued major investments from the likes of Google, Microsoft, Apple, Amazon and ESRI are making consumer-based mapping, location-based service applications and image base maps truly ubiquitous.

Data generation, management and usage

For the US Government, global security threats will drive a growing need to support coalition based operations with shareable geospatial intelligence data worldwide. We will also see continued growth in a wide variety of sensor data including UAVs and UAS. All of this will create more demand for unclassified, shareable data and data fusion services.

In the commercial market, we see continued growth in geospatial data sources (imagery, social media, open source, etc.) Ubiquitous consumer-oriented geospatial applications are capturing massive amounts of rich location-based data daily. The cloud will enable rapid and cost-effective processing, analysis and sharing of these large datasets.

Key challenges

Across both the government and commercial markets the challenges are increasingly big data related. It's the challenge of creating intelligence from a growing flood of geospatial data becoming available. It's also about being able to leverage the power of the cloud and high performance computing to deliver cost-effective and timely geospatial solutions. Ultimately it's about finding a way to turn geospatial data into intelligence and insights for customers.

> "In the commercial market, we see continued growth in geospatial data sources (imagery, social media, open source, etc.) The cloud will enable rapid and cost-effective processing, analysis and sharing of these large datasets."

Sectors that demand skilled geospatial professionals

Professionals with skills able to help solution providers leverage varied growing geospatial data sources, effectively analyse them, leverage the cloud and move solution providers beyond data collection and processing into information service providers will be in demand across both the government and commercial sectors.

Competitive landscape

For US Government, anticipated reductions in defence spending will create an increasingly competitive environment as providers fight to hold onto programs.

Competition will also continue to intensify in the consumer mapping and location based services space, making free maps and imagery ubiquitous and creating the opportunity for providers to develop geospatial applications for the commercial sector that moves beyond providing traditional mapping information and location-based services into higher value cloud-based geospatial services and applications.

Prof. Dr Josef Strobl
Head of Department,
Centre for Geoinformatics (Z_GIS)
Universitat Salzburg

Technology development and application trends

It always is hard to speculate on disruptive innovation, but 'trends' by definition are rooted in the past. Regarding technology, we are facing a much diversified portfolio of sensors, remote as well as in-situ, stationary and mobile. The move towards cloud will intensify, with smart synchronisation for on-/offline continuity having some way to go still. This is the actual foundation for mobile GIS, not so much mobile devices per se.

> The principle of lifelong learning today is much more than a catchphrase, but reality. Professional 're-tooling' is continuously required and more and more is happening on the job.

In the application domain, geospatial is getting more and more personal, as everyday assistance. This pervasiveness, and the spatial awareness and intelligence coming with it, ultimately will be the strongest driver for professional applications across all domains.

Data generation, management and usage

I already mentioned sensors before. More and more, the 'people as sensors' principle, i.e. crowdsourcing will take over as the dominant source of spatial data together with a host of sensors. Traditional surveying and mapping is taking the back stage, while of course still responsible for a few critical base layers. For a broad range of applications it is being replaced by 'street mapping type' data acquisition. This trend towards (i)VGI within a real-time environment truly challenges our data management processes, as well as generating several privacy issues.

Key challenges

Timeliness. Most solutions today depend on real time, and more and more of forecasting, prognostics and scenarios. Describing the presence and detailing the past in many instances is not so relevant any more. Plus, mobile access with good situational awareness – think about augmented reality–and a focus on decision support.

Sectors that demand skilled geospatial professionals

The critical element on the qualification sector is 'change'. The principle of lifelong learning today is much more than a catchphrase, but reality. Professional 're-tooling' is continuously required and more and more is happening on the job. Any kind of (software) training, though, can only work effectively if professionals have a very solid conceptual foundation. Initial education clearly has to focus on developing a geospatial mindset, the foundations for spatial thinking – qualifications with a long half-life. Then ongoing adjustment to evolving technologies can be done easily, as these primarily are ever changing toolsets for geospatial professionals.

Carl Reed
CTO and Executive Director of the
Standards Program
Open Geospatial Consortium (OGC)

Technology development and application trends

From an OGC standards development and interoperability requirements perspective, there are a number of interrelated trends that our membership is addressing with new standards activities. These trends include cloud computing, mobile devices, crowdsourced geospatial content, augmented reality, the Internet of things, indoor modeling and navigation, and the integration of geospatial data with design data, which relates to indoor/outdoor spatial integration.

The proliferation of location-aware, Internet-connected mobile devices brings requirements for service integration and content access and fusion applications that run on the cloud and serve large numbers of users simultaneously. Those users may have limited bandwidth and

intermittent connectivity, and few of them will have professional training in traditional GIS. Potentially, geospatial repositories maintained in the cloud will update in real time. This poses particular problems with respect to intermittent connectivity. Our work with OGC candidate standards for GeoSynchronization and GeoPackage encodings and interfaces will make such applications more useful and easier to manage. Many app developers want very simple location standards and standards that can be used in the programming environments familiar to them, so things like the OGC GeoSMS standard, RESTful services, and the GML point profile will, we think, get a lot of attention.

As web developers become familiar with the geospatial world, they'll learn that some of the OGC standards they see as too "heavy" are heavy because the requirements are inescapably complex.

With the increased market and policy pressure to integrate the massive amounts of location-tagged social media (aka Big Data) issues of data quality and data provenance are moving to the fore as the requirements of geospatial applications become understood in more domains, and so we will see growth in the OGC working groups working on ways to quantify and communicate quality, provenance, and uncertainty.

Big data management, security, and analytics will be important in applications that involve high volume streams of sensor data, from Wide Area Motion Imagery systems for example, and LiDAR. Sensor technology is moving forward rapidly. Our smart phones are full of sensors, and the Internet of Things will be an Internet of embedded devices with sensors and actuators. Something else we will see is rapid growth in civilian use of Unmanned Aerial Vehicles (UAVs), and these will create huge amounts of data and requirements for high volume processing. This is one

> "With growth in the data, there will be growth in data markets. Standards activity in the area of geospatial rights management will gain importance."

reason that Big Data gets talked about so much. Therefore, standards that make it possible to integrate, analyze, and communicate all of this spatial data become critical. With growth in the overall amount of data, there will be growth in data markets, which suggests that standards activity in the area of geospatial rights management will once again emerge as an important standards activity. Concerns about privacy and security gain a higher profile as imaging devices become ubiquitous, and this is another trend that will call for new standards.

Augmented Reality is another area that will grow. This is related to mobile devices with location-based services and it's also related to 3D urban modelling and convergence or integration of indoor and outdoor location paradigms.

Data generation, management and usage

As mentioned above, there will be a dramatic increase in data generation and the volume of geospatial content. This will come as a result of crowdsourcing, mobile location applications, new sensor platforms, and the ever-increasing number of inexpensive, highly capable Internet-connected sensors. Because this growth in data is being accompanied by an increase in the number of users who have no professional training, and because the users, data and processing are less often at a desk and more often using a mobile device, management and usage of all this data will follow new patterns. Traditional users working in activities related to SDIs or the geosciences will find that they are spending much less time with files and much more time with services (think of Google Maps), resulting in new and improved workflows and more division of labor. So, even as we get more citizen scientists and more crowdsourced geospatial content, environmental scientists and managers, for example, will increasingly depend on specialists to collect and curate their data. Data collection and curation will become important for businesses to a greater degree than they are today, because these tasks will require increasing levels of expertise and because specialization yields efficiency.

Key challenges

Solution providers will need to know more about standards. Solution providers will be market driven to consider integrating component software and services designed to communicate via open standard interfaces and encodings. Formal best practices will be important, as well. Just as Web developers scan the Web for specifications, reference implementations, and ideas, geospatial solution providers will scan the Web for things they can weave together into solutions. With open standards, there are more options available and more information available from developers around the world.

Solution providers will also consider how to work with big data and deploy their solutions in the cloud – whether public, private, or hybrid. There is a misconception that one simply moves all their software services to the cloud. This is shortsighted. In order to maximise cost and bandwidth efficiencies, a software and application provider needs to consider business processes, look at functions that require considerable user interaction

and those that don't, look at data volume transfer issues, security and so forth. Only then can the organisation determine which software services make sense to deploy to the cloud and which should stay on the client device – or dedicated desktop server.

There are similar issues with Big Data. New hardware and software technologies, often quite foreign to the traditional GIS provider and user, are required to deal with big data. Technologies such as the Hadoop platform come into play. Traditional GIS architectures may not map well at all to Hadoop and MapReduce. Then there is the issue of analytics and fusion for big geospatial data.

Sectors that demand skilled geospatial professionals

We already see increased demand in many IT domains for people who understand big data, service oriented architecture and data visualisation and games. Geospatial concepts, information architectures, human factors engineering, algorithm development, effective use of standards, and other professional expertise will become more important than learning tools.

One way to answer this question is to suggest that young people look at the current industry roles and imagine them branching into various specialties. Some jobs, of course, will go away due to the advances in technology outlined above. For example, the industry will need fewer people who can manipulate and convert files, because the service paradigm is displacing the file paradigm. Other jobs will arise that use the new technologies to solve societal problems and meet market needs. Another way of thinking about this is to think about what society needs. It's safe to predict that we'll see growth in certain domains like energy and utilities, environment and natural resources, urban infrastructure design and construction, and public health. All of these domains require people who have knowledge of geospatial technology.

Competitive landscape

We'll probably continue to see consolidation in the marketplace, both vertically and horizontally.

Old technologies tend to become commodity-based and they tend to provide a platform for new technologies. As described above, we'll see a lot of new companies emerging to take advantage of new business conditions and new niches. Open standards have become an established part of the competitive landscape. They provide a level-playing field that enables new players to get into the game without investing a lot of time and development resources in creating proprietary encodings and interfaces. There's "plug-and-play" between many components, so entrepreneurs can quickly build solutions that fit innovative business models. Standards also allow existing services and applications to continue to operate in new computing technology environments. This is call future proofing. Standards are used to "wrap" legacy services and applications and this enables integration into new platforms and infrastructures.

Super Wang
CEO, SuperGeo

Technology development and application trends

Since the establishment, Supergeo is dedicated to providing users with state-of-the-art geospatial technologies and comprehensive solutions. To follow recent trend toward developing value-added software and customized applications, we have endeavored greatly in the software enhancement to solve significant spatial data processing and management challenges.

For example, the enterprise-level server GIS, SuperGIS Server 3.1, is able to mash up with other software systems and open source maps easily. Hundreds of Server API samples including Flex, Silverlight, and JavaScript are also provided for users to create web mapping applications with no efforts and costs. For the coming 2013, we will focus on migrating our products to new platforms like Microsoft Windows 8, to enhance the smooth GIS workflow in dissimilar operation platforms for more applications.

Another important trend is to develop various GIS Cloud services to help clients move enterprise applications to the cloud and retain the competitive edge to their business. The Cloud techniques will bring GIS applications with more flexible manipulation, effective data storage and data sharing, as well as more efficient budget plans. On the other hand, we will work on more Mobile applications for iOS/Android phones, to extend GIS application in the field smartly. Last but not least, the 3D advancement for creating 3D displays would be aimed, to bring a more realistic display and analysis environment for SuperGIS users.

Data generation, management and usage

Role of GIS in planning will continue to grow across various applications ranging from disaster control, transportation planning, agriculture

management etc. In the future, the enterprises will benefit from easily obtaining the massive amount of spatial data and high-resolution satellite imagery by GIS and technological innovations.

For example, the rapidly developed UAV technology allows for precise data collection and exploitation where the geographic locations and information are crudely known in the event of an accident or natural disaster such as earthquakes and volcano eruptions. Besides, taking the advantages of comparatively less expensive and faster data processing offered by LiDAR, the newly emerged technology improves the productivity for topographic mapping, creates various elevation models and consequently enables better decision making for accomplishing critical business tasks.

We are in the process of researching for developing more effective data generation, distribution and management mechanism for users. For example, organisations now can effortlessly distribute GIS resources over the Internet to support Desktop, Mobile, and Web applications via the Server-based GIS solutions. The new image cache techniques will enhance the display and manipulation speed of large raster data. The development of SuperGIS Toolkit and Process Designer will bring seamless processing experience of complex geospatial operation for users.

Key challenges

For Supergeo, the key challenge will be to maintain at par its solutions with the new techno-trends in the global information technology industry. As you can see that Cloud computing today is one of the most-discussed topics among IT professionals; therefore, how to develop compatible GIS platforms for helping users create and deploy a Cloud service to public or private clouds becomes fairly crucial to us.

Recently multi-touch sensing has changed the way people interact with computers and a wide range of electronic devices. In this case, we have to develop the software that can recognise multiple touch points simultaneously, allowing for multi-finger actions such as stretching on maps.

With changes in the telecommunications environment, it makes geospatial data more accessible through mobile devices. So far, we have Windows Mobile and Android mobile GIS applications; hence launching practical applications for the exclusive iOS platforms in the coming future becomes a priority in our product development.

To respond to these challenges, Supergeo now engages in developing problem-solving approaches, ensuring that the cloud service, multi-touch support, and the latest telecommunication technology will be supportable over long terms.

Sectors that demand skilled geospatial professionals

Since cloud technology goes mainstream globally, IT professional's skills have remained relevant to cloud computing. The change will include building and supporting users to manage GIS services in the cloud and even on mobile devices. To fulfill the demand in the GIS market in near future, IT professionals will need to adjust and improve their technical skills to function within the Cloud.

> "We will focus on migrating our products to new platforms like Microsoft Windows 8, to enhance the smooth GIS workflow."

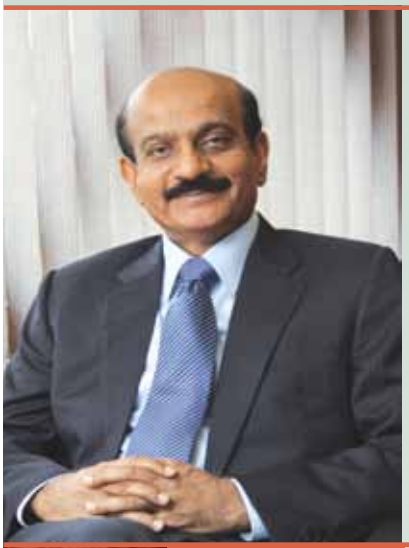
Furthermore, as the market demand surges for apps to run on GPS-equipped smart phones, it brings new business opportunities to GPS-enabled mapping applications. Therefore, application developers and designers who have professional knowledge of touch interfaces and geospatial technology of the mobile devices are still in high demand.

With the above discussed trends, the demand for skilled geospatial specialists will surely increase. More and more professionals will be needed to develop value-added applications for users, since the geospatial technologies are spreading out to reach more domains.

Competitive landscape

As emerging market economies grow, they will generate potential business opportunities globally. Compared to Western countries, many emerging markets such as Africa, Southeastern and Southern Asia, Eastern Europe etc. have enormous natural resources and domestic development plans like transport construction that yield to high demands for GIS products.

Instead of looking for existing expensive offerings offered by the providers from US and Europe, clients in the emerging markets require an affordable, reliable and workable alternative GIS solution. Therefore, identifying unmet needs in emerging markets is vital to the young geospatial solution providers. The flexible services and reasonable pricing would be important competitive landscape for future industry evolvement. For the coming years, we expect that cost-effective GIS hardware or software produced by new market providers like Supergeo will be employed widely and globally to assist governments, enterprises, and general users in fulfilling their mapping applications and further encouraging the users of GIS technology in day-to-day navigation. We will surely play an indispensable role and keep promoting the solutions for worldwide users.



Dr BVR Mohan Reddy
CMD, Infotech Enterprises

Technology development and application trends

- **Open source GIS:** It will continue to grow and start to take its place among the commercial options as preferred desktop, mobile, and online mapping software
- **Cloud:** GIS will move beyond the simple display and query of online mapping and companies will debut technology that provides more analytical and data processing capabilities via the cloud
- **Enterprise GIS:** It will continue to grow with SaaS delivery model. Integration of geospatial technologies into mainstream like ERP, BI, Design and e-Gov will continue
- **HTML5:** Last couple of years have witnessed incredible innovation and progress in Web browsers. With their huge presence across desktop, mobile and tablet devices, Web browsers have become a crucial component and the platform for many modern applications. A whole new set of capabilities available in modern browsers has been gathered under the term HTML5, which is a preferred technology for online mapping
- **3D and 4D:** 3D and even 4D geospatial information, incorporating time as the fourth dimension, will increase
- **Satellite remote sensing technologies:** These technologies have been tested and are currently widely suggested for use as a tool for monitoring, assessment and verification of carbon pool from natural resources such as forests
- **Usage of point clouds in geospatial workflows:** There is a trend towards greater use of point clouds in geospatial workflows to capture the as-built or as-is nature of infrastructure or terrain. Point clouds have become cheaper to capture using ever-advancing but more cost-effective scanning technology

Data generation, management and usage

Data generation

- Volunteered geographic information (VGI) and crowdsourcing emerged as tremendous methods of collecting user-generated content
- Web 2.0 has been the driving force behind the rise of user-generated content in a variety of disciplines
- Volunteered and crowdsourced contributions are frequently difficult to integrate with existing resources because they are often incomplete, unattributed, loosely structured, and syntactically incompatible with existing geospatial frameworks that maintain a common, consistent projection environment and metadata schema. Because they are created and contributed by end-users rather than by an official agency, they are often considered to be unreliable
- Beyond these issues of accuracy and temporal currency, VGI and crowdsourcing have a transformative effect on community by changing the value of geospatial information and its role in government by fostering transparency, citizen engagement, and citizen participation in decision-making

Management and usage

i) Cloud Computing: Both public and private cloud models share key characteristics such as:

- Multitenancy: A pooled and shared infrastructure for commonly leveraging virtualisation
- Self-service: A friction-free environment for consuming services
- Elasticity and scalability: The ability to dynamically meet unpredictable loads
- Metered services: Transparency into the traffic and load of the applications and servers accessed

Private Cloud: This model enables an organisation to control physical location, data management, regulatory compliance, governance, and security

ii) Big Data: Mapping and GIS software are perfectly poised to take advantage of large data sets. Multi-layered analysis, engaging visuals and predicative analytics ensures that big data becomes an asset and not a liability

Key challenges

- Technology limitations
- Advanced graphical data display
- Integration with cloud technologies (GIS vendors are struggling to deploy GIS software in the field of cloud

computing, as there is lack of standardisation and technical support for GIS products)

- Total visualisation and 3D modelling

- Need to meet governmental regulations
  - Various governments have passed regulations related to national security and individual privacy, which affect the standardisation of the products in the Global GIS market
- Cost of digitizing maps
  - Cost of high-resolution satellite imagery
  - Cost for end users
- Real-time map updates
  - Time to market
  - Data exchange between different applications
- Accuracy of Crowdsourced data
  - While leveraging crowdsourced data seems like the next step in gathering and managing geospatial information, much of this data can be faulty at times – since many online sources may be sharing misinformation or the information may be simply outdated

Sectors that demand skilled geospatial professionals

Skills

- Visualisation skills: Cartography will remain the language through which the data explosion will be spatially interpreted. The growth in 3D and especially 4D data capture will set major new challenges for those required to express the resultant information in any meaningful manner
- Data modellers: Highly skilled data modellers –with a range of competencies and ability to understand complex and time based data is a priority
- Spatial information manager: Most organisations will need to get a handle not only on spatial data created internally, but the huge amounts external to the organisation that impact organisational processes. This is more than data management, it means a high need for people who understand spatial data and how the dots connect
- 3D spatial analysis: Rapid expansion of 3D visualisation, LiDAR and surveying instrumentation that creates 3D data and the development of true 3D GIS, all place us into 3D frameworks. It does not make sense to continue using LiDAR and laser scanning technologies without rapidly innovating through spatial analysis of all that data. Indeed, modeling will require improved 3D understanding
- Geo-social coordinator: Geo-social coordinator knows how geospatial tools and technologies link to social media. In order to move through different environments, and to develop new possibilities for distribution of spatial data, these people will be particularly savvy when it comes to a wide range of smartphones for geospatial use
- GIS analyst: According to CNN GIS Analyst is one of the "100 top careers

> "Multi-layered analysis, engaging visuals and predicative analytics will ensure that big data becomes an asset and not a liability."

Sectors

- The demand for professionals with geospatial skills has been consistently increasing in various sectors including municipalities, police, environmental agencies, utility companies, oil industry, emergency management, food production, intelligence, public safety, real estate and telecommunications, among other fields

Competitive landscape

- Green business: Green design and production are considered as means of reducing or eliminating environmental impacts while maintaining quality of life by using careful assessment and clever design techniques for developing eco-friendly products and processes that are less harmful as compared to the conventional ones. Today, green business is the top priority on the innovation agenda of many companies. This agenda today not only poses challenges, but also opens up significant innovation opportunities. The concept of green business has the power to transform the competitive landscape across sectors, and will force customers to change the way they think about products, technologies, processes, and business models
- Shift in product offering for PND vendors: Shifts in the product offerings by personal navigation device (PND) vendors can be seen as a bid to prevail in a market that is expected to decline by over 40 per cent by 2016, reports ABI Research
- Consolidation in GIS market: In 2012, a number of acquisitions took place in the GIS market. Such examples incudes DigitalGlobe's merger announcement with GeoEye for $900 million, Amazon.com acquired UpNext, Esri acquired GeoIQ and Maptel, and TerraGo Technologies acquired Geosemble

Rajesh Mathur
Vice Chairman, NIIT – GIS Ltd

Technology development and application trends

Cloud and Web will continue to be major GIS data and service delivery platforms. As users migrate to enterprise system comprising a comprehensive GIS catering to the needs of various departments and locations, Cloud would be the most effective environment to make usage pervasive. In Indian context we will probably find in-premises Cloud to be preferred over Public Cloud in view of security concerns. Mobile technology is also gaining traction as the platform for consumption of services. In India with more than 900 million mobile phones in use mobile has the potential to be an effective device for consumption of content and services especially for citizen-centric applications.

Another interesting phenomenon to watch is Big Data which would be very relevant for geospatial technology. Data plays critical role in usage of geospatial technology and as contemporary GIS technology facilitates access to data residing anywhere and its deployment in Web/Cloud based applications, Big Data will enable service providers to enhance the analytical capabilities of their applications.

Location Analytics is emerging as one of the fastest growing segments for geospatial technology. Geospatial analytic tools offered by companies like Esri and its partners are allowing users to integrate geospatial services with other IT systems leading to deeper insights into the business dynamics. We are going through exciting times and experiencing major transformation taking place in deployment of geospatial technology in enterprises. From departmental GIS we have graduated to one GIS for the whole organization.

Other applications to watch are business intelligence, exploratory regression among others.

Data generation, management and usage

Traditionally the business of national mapping agencies has been creation of maps and hence focus has been on digital cartography. While there cannot be any compromise on adherence to cartographic guidelines and standards, the mapping agencies have to now cater to the needs of GIS users. They need to focus on making data GIS ready in order to meet the requirements of the user community. This would necessitate greater attention to interoperability, adherence to standards et al.

> “Cloud and Web will continue to be major GIS data and service delivery platforms. In Indian context we will probably find in-premises Cloud to be preferred over Public Cloud.”

Geospatial technology is getting embedded into various government systems and processes. This would require new approach to dealing with creation, management and dissemination of geospatial content. National and State Geospatial Data Centres would have to evolve into National and State GIS with focus on services delivery. Having said that, I would also add that NSDI and State SDIs will continue to exist and facilitate content delivery to users and service providers. Regulatory framework will also require review to facilitate access to geospatial content by users, application developers, service providers and other stakeholders.

Key challenges

Technological developments in geospatial technology are creating opportunities for enhanced value creation for the users by way of greater access to data and services. However, it is also creating new challenges for solution providers who need to upgrade the skills of their development staff in order to leverage the power of the contemporary GIS technology. Geospatial professionals have to significantly enhance their IT skills and become more proficient in Cloud, Web, Mobile, RDBMS, various development platforms like .net/Java, Python, Silverlight at al.

Cloud GIS is creating new business models for users to consume data and services. These are subscription based wherein customers are charged on per use basis. Geospatial solution providers will have to migrate their applications to Cloud and adapt them to peruse billing model.

Sectors that demand skilled geospatial professionals

As said earlier, geospatial professionals will have to acquire deeper knowledge of IT tools and development platforms. They will also have to enhance their understanding of Cloud, Web and Mobile. Integration of GIS applications with other IT sub systems like ERP,

SCADA, CRM, BI will require good understanding of these applications.

Traditional GIS applications in various domains like urban, utilities, disaster management, natural resources, land records, security, among others will continue to grow. In several cases developers will have to migrate existing desk top applications to Web/Cloud. In addition, emerging applications like location analytics, business intelligence, will require domain knowledge and familiarity with the tools.

One of the skills which is often found to be lacking in geospatial professionals is project management. This leads to time and cost escalation in completion of projects resulting to client dissatisfaction. Academic institutions conducting courses on Geospatial technology must ensure sessions on project management. Several institutions like University of Redlands and NIIT University have recognised it and included project management as one of the courses in their Master's program on GIS.

Competitive landscape

The existing stakeholders in the Geospatial ecosystem will have to adopt the new paradigm which requires Web/Cloud-based content and service delivery. Core technology providers will have to upgrade their offerings to the new platforms. Application developers will be required to migrate their solutions to the Web/Cloud. They will also have to review their pricing and other commercials to align to subscription-based business model.

We will also witness emergence of new entrants who would be offering Web/Cloud-based services to clients opting for subscription based models. There would also be opportunities for system integrators who will set up in premises cloud for customers opting for private cloud.

Competitive landscape is poised for major changes with emergence of new players in the Geospatial ecosystem.

Bobby Kalra
CEO, Magnasoft

Technology development and application trends

Today we are seeing an increase in the importance of geographic information for the consumer. Geographic information means more intelligent technology and this is what we find people are striving to achieve through technology and application development. With this in mind we feel that 2013 will see a rise in trends that use geographic information systems or enhance them.

This means that there will be a significant rise in the number of mobile phone applications with location based services. 2012 has already seen the launch of several location based services such as City Lens and Nokia nearby and this trend is only likely to continue. In addition to this already existing applications will use location based services to enhance the overall consumer experience.

A rise in the number of Location Based Services also means a rise in the data generated by Geographic Information Systems adding to the already mounting amounts of data. Big Data management will therefore continue to be prominent in the coming year and will be critical in helping technology give consumer's accurate, timely and accessible data.

GIS systems itself will become more and more sophisticated in their functioning. There will be a rise in web-based distributed mapping applications and a move to mapping in the cloud. There will also be an emergence of Global Navigation Satellite Systems (GNSS) to supersede traditional GPS.

Data generation, management and usage

As location based services and mapping technologies are gaining prominence, there is a quantum increase in the amount of inflowing geospatial data. This data are of different formats and from sources as varied as satellites, unmanned aerial vehicles (UAV) to social media data. This variation in data types and data sources makes data management and usage a complex process.

Not only is the increase significant, but today people realise the importance of the data in gathering intelligence for solving the consumer's problems, branding, customer relationship management and a variety of other applications. How this will work is that the incoming data will be stored in gigantic databases. The data will then be quickly and elegantly accessible using big data mining techniques and provide the consumer with real-time intelligence from a particular location.

An example for the intelligent use of geospatial data via big data mining techniques is traffic intelligence. The technology recently updated on Google maps will enable consumers to gauge the traffic situation in real-time to make wiser choices of roads to avoid traffic while on the move.

While the benefits of the intelligent use of Geospatial data are many, there are also challenges in using such data. The representation and interpretation of geospatial varies across geographies. For instance typically countries in South Asia – like India – create and consume GIS data differently from

other locations. This makes the overall big data integration all the more complex.

Key challenges

The accessibility of geospatial data opens the doors for privacy breaches and misuse by private and public organisations who are both providers and consumers of GIS data. There is today a need for accountability with regard to the use of geospatial data and constant vigilance of its use. In addition there needs to be a set of established ethical standards for the same.

While the existing geospatial data is today mostly in the public domain, down the line GIS data will encounter privacy, national security, liability and intellectual property issues. For instance, disputed borders such as in the case of India, China and Pakistan in the maps on the Internet have become a topic of debate. People are also increasingly asking for Free and Open Source Software (FOSS) access to geospatial data. Google maps and its rapid evolution is a good example in this case.

Further, application and technology developer will strive to bring down the cost of geospatial data collection, analysis and result delivery and there will be the proliferation of fully-automated expert systems/decision systems.

Sectors that demand skilled geospatial professionals

Today the application of location based services in various areas is becoming prominent and with people perceiving its benefits in areas such as e-governance, indoor tracking and national security, the need for skilled professionals in these areas are likely to increase. There will be a rising need for the accountability, transparency, optimisation and efficiency in these areas which is what will cause the rise in demand. In addition to this mobile location-based intelligent advertising which is already quite popular is only going to see an increase in demand of skilled professionals who will have to use a combination of technical intelligence and creativity for its implementation.The skills that are in demand in these sectors include mobile application development on a variety of operating systems-especially iOS and Android, and to a smaller extent Windows mobile OS. Professionals would also be expected to be skilled in cloud development which has become very popular. In addition to this they will require knowledge of C#/.NET on ESRI products and Java/J2EE on open source mapping products.